

CLAIMS

1. Electrical switching device comprising at least one electrical contact able to be kept in
5 a stable position by magnetic means,
characterized in that it comprises:

- at least a first part (30) comprising at least a first magnetizable element (31) and a first
contact zone (32) associated with said first magnetizable element,

- at least a second movable part (33) comprising at least a second magnetic element (34) and
10 a second contact zone (35) associated with said second magnetic element, said second
movable part (33) having at least a first stable position to keep a first electrical contact (36)
closed between the first and second contact zones (32, 35) and a second stable position to
keep said first electrical contact open, and

- electromagnetic actuating means (53, 54) acting on the second movable part to make the
15 latter change position and comprising at least a first electromagnetic coil (53) wound onto at
least a first magnetizable element (31) of the first part to act in attraction or repulsion on at
least a second magnetic element (51) of the second movable part (33) and to perform a
change of stable state of said second movable part,

the first or second magnetic element comprising at least one permanent magnetization part
20 (38, 51, 103) to keep the first electrical contact closed (36) and exert a contact pressure
between the first and second contact zones (32, 35) by a magnetic attraction exerted between
the first and second magnetic elements (31, 34, 38, 51, 103) when the movable part is in its
first stable position.

25 2. Switching device according to claim 1, characterized in that the electromagnetic
actuating means comprise at least a second electromagnetic coil (54) wound onto at least a
third magnetizable element (39) of the first part to act in attraction or in repulsion on at least
a second magnetic element (52) of the second movable part (33) and to perform a change of
stable state of said second movable part.

30 3. Switching device according to claim 2, characterized in that the first and second
electromagnetic coils (53, 54) are designed to be controlled by electrical pulses to generate

reverse magnetic fields performing a repulsion and an attraction and to make the stable position of the second movable part (33) change between a first and a second stable position closing at least one electrical contact (36) between a contact zone (32) of the first part and a contact zone (35) of the second movable part (33).

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4. Switching device according to one of the claims 2 or 3, characterized in that the first and second electromagnetic coils (53, 54) are designed to be controlled by electrical pulses to generate magnetic fields of the same direction performing two repulsions and to position the second movable part (33) in a third stable position where the contact zones (35, 43) of the second movable part (33) are not in electrical contact with the contact zones (32, 42) of the first part (30).

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5. Switching device according to any one of the claims 1 to 4, characterized in that the first part comprises a third magnetizable element (39) to keep the second movable part (33) in the second stable position.

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6. Switching device according to any one of the claims 1 to 5, characterized in that the second movable part (33) comprises at least one permanent magnet (51, 52, 103, 104) arranged in proximity to a contact zone (35, 43).

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7. Switching device according to any one of the claims 1 to 6, characterized in that the second movable part is composed of a material (103, 104) comprising a mainly permanent magnetization part.

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8. Switching device according to any one of the claims 1 to 7, characterized in that the permanent magnetization part or the permanent magnet (38, 51, 52, 103) have a magnetic induction greater than 1 tesla.

9. Switching device according to any one of the claims 1 to 8, characterized in that the second movable part (33) has an elongate shape able to pivot and comprises at least one contact zone (35, 43) and one magnetic attraction zone towards at least one end.

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10. Switching device according to claim 9, characterized in that the second movable part (33) comprises at least one contact zone (35, 43) and one permanent magnet (51, 52) at a first end and at a second end.

5 11. Switching device according to any one of the claims 1 to 10, characterized in that the second movable part (33) has a flexible constitution able to be fixed by a point (100) situated in a central zone, and comprises at least one contact zone (35, 43) and one magnet (51, 52) towards at least one end.

10 12. Switching device according to claim 11, characterized in that the second movable part (33) comprises at least one opening (102) to a central zone.

13. Switching device according to any one of the claims 1 to 12, characterized in that:

15 - the first part (30) comprises the first magnetizable element (31) associated with a first contact zone (32) and a third magnetizable element (39) associated with a third contact zone (42), and

- the second movable part (43) comprises a second contact zone (35) towards a first end designed to be in contact with the first contact zone (32) of the first part, and a fourth contact zone (43) towards a second end designed to be in contact with the third contact zone (42) of the first part,

20 in a first stable position of the movable part, the first and second contact zones (32, 35) are maintained to form a closed contact and the third and fourth contact zones (42, 43) form an open contact, and in a second stable position of the movable part, the third and fourth contact zones (42, 43) are maintained to form a closed contact and the first and second contact zones (32, 35) form an open contact.

25 14. Switching device according to claim 13, characterized in that the first, second, third and fourth contact zones (32, 35, 42, 43) are electrically connected to electrical connection means (44, 62, 62A, 62B, 71, 72, 73).

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15. Switching device according to one of the claims 13 or 14, characterized in that the second movable part (33) comprises a first permanent magnet (51) towards the first end to

operate in conjunction with the first magnetizable element (31) of the first part and a second permanent magnet (52) towards the second end to operate in conjunction with the third magnetizable element (39) of the first part.

- 5 **16.** Switching device according to any one of the claims 13 to 15, characterized in that it comprises maintaining means (55) to keep the second movable part (33) in a third stable position wherein the contact (36) formed by the first and second contact zones (32, 35) and the contact (41) formed by the third and fourth contact zones (42, 43) are open.
- 10 **17.** Switching device according to claim 16, characterized in that the maintaining means comprise a support element (56) in the form of a flat part arranged on the first part to receive a first side (57) of the second movable part and pressure means (58) to keep a central zone (59) of the second movable part against said support element.
- 15 **18.** Switching device according to claim 17, characterized in that the pressure means (58) are formed by a spring.
- 19.** Switching device according to claim 17, characterized in that the pressure means (58) are formed by a third permanent magnet (60) and a fourth magnetizable element (61)
- 20 arranged on the support element and on the central zone of the movable part.
- 20.** Switching device according to any one of the claims 1 to 19, characterized in that it comprises manual or mechanical actuating means (50) acting on the second movable part (33) to make it change stable state.
- 25 **21.** Switching device according to any one of the claims 1 to 20, characterized in that the second movable part (33) has a flexible constitution able to be fixed by a point (100) situated in a central zone, and comprises at least one contact zone (35, 43) and a magnet (51, 52) with two ends to form two contacts (36, 41) with contact zones (32, 42) of magnetizable
- 30 elements of the first part, said two contacts being able to be closed simultaneously.

22. Switching device any one of the claims 1 to 21, characterized in that at least one magnetic or magnetizable element (31, 39, 61) enables an electric current designed to flow in at least one electrical contact (36, 41) to be conducted through the material that constitutes it.

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23. Electromagnetic relay with at least two stable states comprising at least a first and a second electrical contact inputs (62A) and control inputs (62B), characterized in that it comprises at least one switching device according to one of the claims 1 to 22, the first electrical contact input being connected to the second movable part (33), the second electrical contact input being connected to a first contact zone (32) of the first part, and the control inputs (62B) being connected to at least a first electromagnetic coil (53) arranged on at least a first magnetizable element (31) of the first part.

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24. Relay according to claim 23, characterized in that it comprises at least a second electromagnetic coil (54) connected to the control inputs (62B) and arranged on at least a third magnetizable element (39) of the first part.

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25. Relay according to claim 23 or 24, characterized in that it has at least three stable states and comprises a third contact zone (42) connected to a third contact input and means (60, 61) for keeping the second movable part (33) in a third stable position where the electrical contacts between the first, second and third contact zones (32, 35, 42) are open, the first and second electromagnetic coils (53, 54) being designed to be commanded in attraction and repulsion to establish an electrical contact and in double repulsion to open the contacts.

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26. Electrical apparatus comprising at least a first and a second electrical contact inputs (71, 72), characterized in that it comprises:

- at least one switching device according to one of the claims 1 to 22 with at least two stable positions, the first electrical contact input (71) being connected to the second movable part (33), the second electrical contact input (72) being connected to a first contact zone (32) of the first part, and

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- a control circuit (70) connected to at least a first electromagnetic coil (53) arranged on a first magnetizable element (31) of the first part.

27. Electrical apparatus according to claim 26, characterized in that the switching device
5 comprises at least a second electromagnetic coil (54) connected to the control circuit (70) and arranged on at least a third magnetizable element (39) of the first part.

28. Electrical apparatus according to one of the claims 26 or 27, characterized in that the
switching device has three stable states and comprises a third contact zone (42) connected to
10 a third contact input (73) and means for keeping the second movable part (33) in a third stable position where the electrical contacts between the first, second and third contact zones are open, the first and second electromagnetic coils (52, 53) being designed to be commanded in attraction and repulsion to establish at least one electrical contact and in double repulsion to open the contacts.

15 29. Electrical apparatus according to any one of the claims 26 to 28, characterized in that it comprises manual or mechanical actuating means (50) acting on the second movable part (33) to make it change stable state.

20 30. Electrical apparatus according to any one of the claims 26 to 29, characterized in that the control circuit (70) comprises at least one control input (74) able to receive control signals.

31. Electrical apparatus according to claim 30, characterized in that the control signals
25 applied to the input can be polarization signals (90, 91, 92), pulse duration signals (93) and/or number of pulse signals (94).

32. Electrical apparatus according to any one of the claims 26 to 31, characterized in that
the control circuit (70) comprises at least one remote control input (81) by communication
30 bus to receive control signals.

33. Electrical apparatus according to any one of the claims 26 to 32, characterized in that the control circuit comprises remote control receipt means (80, 82) to receive control signals.

5 34. Electrical apparatus according to any one of the claims 26 to 33, characterized in that the control circuit comprises processing means (79) to process control signals and to control the electromagnetic coils according to said signals.

10 35. Electrical apparatus according to claim 34, characterized in that the processing means (79) perform remote control switch, time switch and/or controlled switch functions.